SYNOPSIS

FOR THE AWARD OF THE DEGREE OF DOCTOR OF PHILOSOPHY IN GEOGRAPHY

Ph.D. Thesis entitle

"HEALTH CARE CENTRES AND ITS ACCESSIBILITY IN KASARAGOD DISTRICT: A GEOGRAPHICAL STUDY"

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"Health Care Centres and Its Accessibility in Kasaragod District: A Geographical Study"

1. INTRODUCTION

Health care is all about improving a person's overall well-being, both physically and mentally. It focuses on preventing, diagnosing, treating, and managing diseases, injuries, and other health conditions. True health isn't just the absence of illness or injury, but a state of complete physical, mental, and social well-being. Living a healthy lifestyle plays a crucial role in reducing the risk of illness and boosting overall health. For instance, staying healthy can protect and improve things like lung function, heart health, strength, flexibility, and body composition.

Health geography is the study of health, illness, and medical care with the help of geographical data, perspectives, and methods. On the other hand, traditional medicine involves practices, knowledge, and beliefs that use manual techniques, exercises, spiritual therapies, and natural remedies—like plants, animals, and minerals—to treat, prevent, or preserve health.

1.1.Medical Geography

Health geography focuses on how healthcare systems affect communities and the accessibility of medical services. The best healthcare systems ensure that healthcare is adequate, available, affordable, and feasible for everyone. A healthy environment provided by healthcare benefits everyone in the community. Raising awareness, particularly in schools and among the public, is key to preventing the spread of infectious diseases.

Healthcare access varies widely around the world. In developed countries, strong infrastructure often means plenty of well-equipped facilities and skilled medical professionals. But in developing countries, access to healthcare can be much more limited due to challenges like poverty, geographical isolation, and insufficient funding. Many rural areas lack basic healthcare services, making it necessary for people to travel long distances to receive care. This gap in healthcare access has serious effects on global health, leading to big differences in life expectancy and disease burdens between developed and developing nations. The World Health Organization (WHO) has long advocated for healthcare as a fundamental human right. According to WHO, healthcare should be available to everyone, no matter their income, location, or other factors. This belief is based on the idea that good

health is crucial for personal development, overall well-being, and the progress of societies as a whole.

1.2.Accessibility

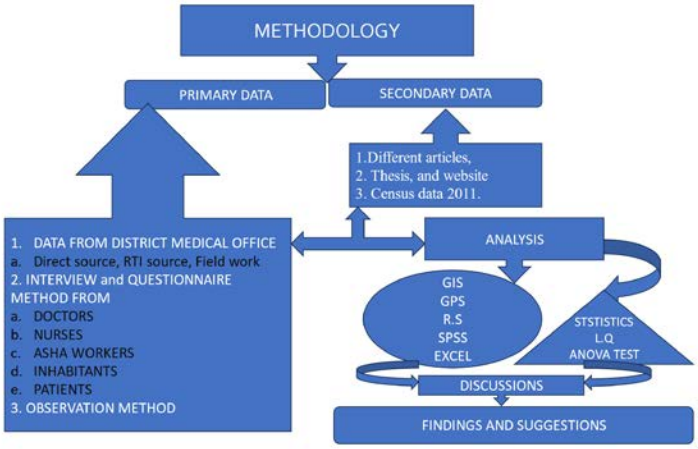
Health is more than just being free from illness or disability—it's about achieving overall physical, mental, and social well-being. Much like water, food, or energy, good health is a vital resource. It's not just the absence of disease, but a holistic state of well-being that includes physical, social, and mental health. Unhealthy habits like poor eating, lack of exercise, smoking, substance abuse, and risky sexual behaviours can harm this balance. Adopting a healthy lifestyle reduces the risk of illness and boosts overall physical health. For example, maintaining good health helps protect and improve vital functions like breathing, heart health, muscle strength, flexibility, and body composition.

Healthcare accessibility refers to a person's ability to reach, afford, and engage with healthcare services. It includes factors like the availability of medical facilities, how easy it is to access them, and the financial feasibility of using them. Having healthcare facilities available in a community encourages people to seek care and can ultimately lead to better health outcomes. However, in countries like India, there's a significant gap in healthcare access, leading to a strained system and limited availability of care for many.

2. OBJECTIVES OF THE STUDY

a. To find out the location of all public and major private healthcare centres
b. To access about the population-based public health care centres distribution
c. To know the health care centres' availability of workforce and infrastructure
d. To access the healthcare facilities' accessibility by distance, time and expense.
e. To understand the district's residents' access to tertiary healthcare centres for Major illness

Figure1. Methodology of the Study



The brief sketch of the proposed thesis is as follows:

Chapter I- The Theoretical Framework of Research in Medical Geography

The first chapter of the outline sets the stage for a comprehensive exploration of healthcare centres in the Kasaragod district. It begins by providing a clear introduction to these healthcare centres, offering insights into their role in the community and the services they provide. The chapter then delves into the key issues facing these centres, shedding light on the challenges they encounter, whether it's related to infrastructure, staffing, or accessibility.

A review of existing literature follows, summarizing previous research and findings on healthcare in the district or similar areas. This section helps to frame the current study within the broader context, showing where it fits in with what’s already known and identifying gaps in knowledge that the research aims to address.

Next, the chapter outlines the specific objectives of the study—what the research aims to achieve and the key questions it seeks to answer. This could include understanding the quality of healthcare services, identifying systemic problems, or exploring community satisfaction.

The methodology section describes the research approach, explaining how data will be collected, analysed, and interpreted. It outlines whether the study will involve surveys, interviews, field observations, or other methods to gather information from both healthcare providers and the local community.

Finally, the chapter discusses the limitations of the research. This is an important section that acknowledges potential challenges faced during the study, such as difficulties in collecting accurate data, issues with methodology, or biases that could influence the findings. By identifying these limitations upfront, the study ensures transparency and helps readers understand the context within which the conclusions are drawn.

Chapter II: Review of Literature of Healthcare System

The second chapter focuses on the review of literature, where existing research and studies related to the healthcare system in the study area are examined in detail. This chapter looks at key components that shape the healthcare landscape, including **accessibility to services, GIS in healthcare accessibility and availability, infrastructure, the healthcare workforce, the socio-economic structure of the community** are mentioned.

First, the chapter delves into the **infrastructure** of the healthcare system, exploring the physical facilities, equipment, and resources available at healthcare centres. It looks at whether healthcare facilities are well-maintained, adequately equipped, and capable of providing the necessary services to the community

Next, the review turns to the health **workforce**, examining the availability, training, and distribution of healthcare professionals, such as doctors, nurses, technicians, and other medical staff. It considers the challenges related to staffing, such as shortages, overworked professionals, or gaps in specialized care, and how these factors impact the quality of healthcare delivered.

The **socio-economic structure** is also explored in this chapter, as it plays a significant role in determining health outcomes. The literature review looks at factors such as income levels, education, employment, and living conditions, which can all affect access to healthcare and overall health. It considers how socio-economic disparities influence people's ability to seek medical care, afford treatments, or even stay healthy in the first place.

Finally, the chapter reviews a**ccessibility**, focusing on how easy or difficult it is for people to access healthcare services. This includes physical access, such as the distance to the nearest healthcare facility, and financial access, such as the affordability of healthcare services. It also considers cultural or social barriers that may prevent certain groups from seeking care, as well as the availability of transportation, especially in rural or isolated areas.

By reviewing this body of literature, the chapter helps to frame the current study within the broader context, showing what is already known about these factors and identifying gaps in knowledge that the research aims to fill. It sets the stage for understanding the challenges faced by healthcare systems in similar regions and offers insights into potential solutions or improvements.

1. The findings show that the ICA reduces disparities between data- and model-based catchment areas and classifies healthcare facilities into core, stable, uncertain, or remote areas. The study also found that traditional catchment areas overestimate and unevenly disperse the accessibility of Shenzhen's elite hospitals, compared to the ICA approach.
   (Pan X, Kwan MP, Yang L, Zhou S, Zuo Z, Wan B. Evaluating the accessibility of healthcare facilities using an integrated catchment area approach. International Journal of Environmental Research and Public Health. 2018 Sep;15(9):2051).

2. The annual report on healthcare workforce and infrastructure offers a comprehensive overview of facility performance (Kuhlmann et al., 2021). It details the number of healthcare providers, identifies equipment and supply gaps (Weitlauf et al., 2014), and evaluates human resources and infrastructure. The report also covers management strategies, including oversight, resource allocation, health financing, and community involvement. This information helps healthcare decision-makers identify system strengths and weaknesses, guiding decisions on resource allocation, capacity building, and quality improvement. Additionally, it supports the development of clinical guidelines and reimbursement policies.

3. Awlachew Dejen, Sandeep Soni, and Fisha Semaw (2019) analyzed the spatial accessibility of healthcare centers in Gamo Gofa Zone, Ethiopia, using geospatial techniques. They applied AccessMod 4.0 in ArcGIS 9.3.1, incorporating satellite data, DEM, road networks, population, and healthcare center locations. The study examined walking and driving mobility, considering 30- and 60-minute travel times. Results showed that 12.62%, 36.60%, 29.10%, and 59% of the population could reach healthcare centers by walking for 30 and 60 minutes, and through a combination of walking and driving.

4. Sibi, K J. (2020). *Socio-Economic Determinants in Health Care*. Stress levels vary, but those with higher education, wealth, and social standing tend to manage it better. Families with strong financial and educational backgrounds have health advantages. Public health policies impact access to healthy living and contribute to health disparities, reinforcing social class divisions. Health is shaped by genetics, environment, lifestyle, and nutrition, with medical care influenced by family socioeconomic status. Socioeconomic factors also affect lifestyle and nutrition, and socioeconomic justice can reduce health disparities.

Chapter III: An Overview of Study Area

The third chapter provides an in-depth overview of the study area, giving readers a clear picture of its geographical and environmental characteristics. It begins by describing the location of the area, outlining where it is situated within the larger region, and providing context about its surroundings. The chapter then explores the physiographic features of the land, such as the terrain, elevation, and drainage patterns that shape the area's landscape.

It also covers the climate and temperature, detailing the typical weather conditions and how they vary throughout the year. This section might look at seasonal changes and how these influence daily life and local activities. Rainfall is another key factor, with the chapter discussing the amount and distribution of rainfall across the region, highlighting how it impacts agriculture, water resources, and the overall ecosystem. Land utilization is examined to understand how the land is used for various purposes, such as agriculture, residential areas, or industrial development. Soils and natural vegetation are also discussed, as they play a crucial role in the region's agricultural productivity and ecological balance. By examining the types of soil found in the area and the natural vegetation that grows, the chapter helps to reveal the environmental factors that support or hinder farming and other land-based activities. Overall, this chapter paints a detailed picture of the study area, setting the stage for understanding how its geography and environment influence the health and well-being of its residents, as well as the challenges and opportunities that come with it.

Figure:1 Location Map:

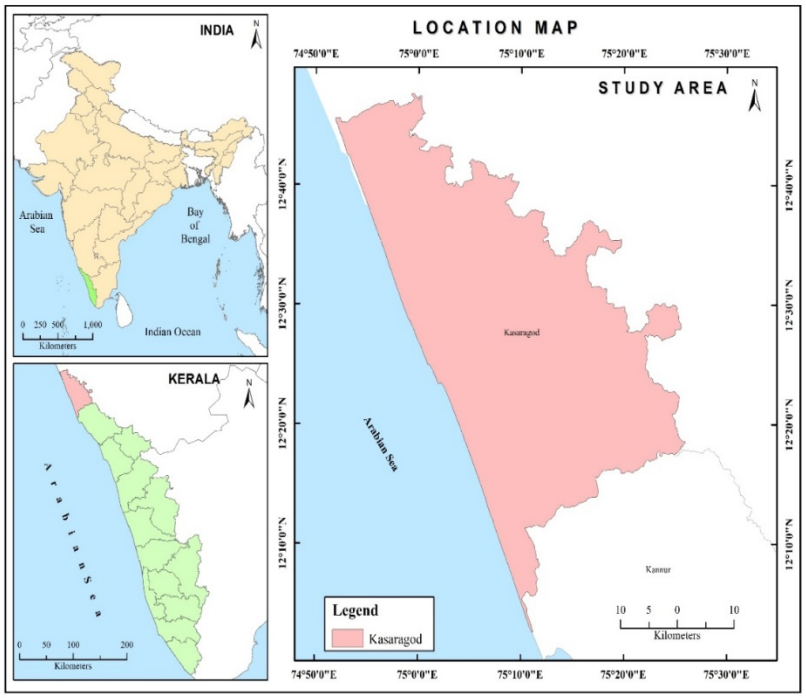
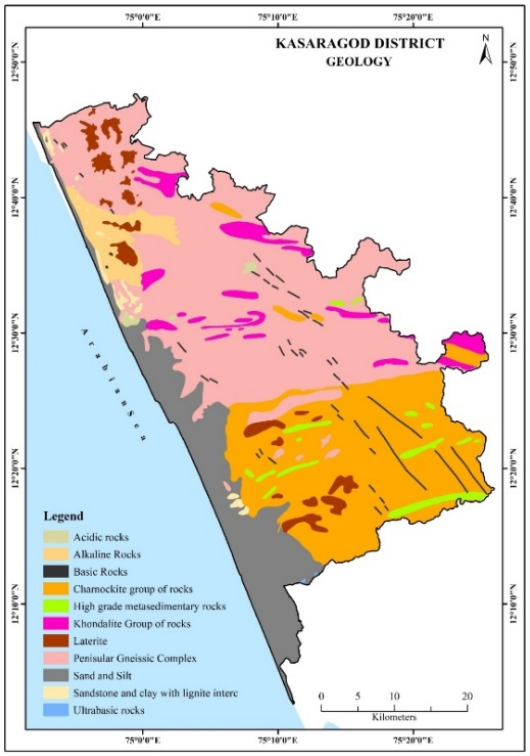
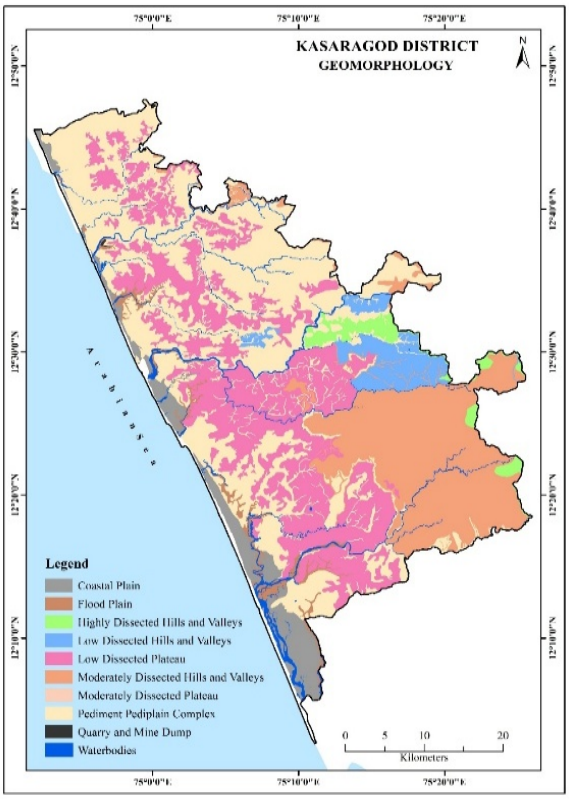


Figure:2 Geology



The region features various geological formations, including (i) northern gneiss, (ii) southern charnockitic rocks extending further south, (iii) a syenite pluton in the center, and (iv) isolated sedimentary rock layers (Warkalli Formation) along the coast. Additionally, (v) Quaternary deposits cover parts of the coastal plain. The area is part of the Precambrian metamorphic shield, predominantly composed of Archaean rocks. Along the western edge, there are patches of Warkalli Formation and Quaternary alluvial deposits. Lateritization has affected both Tertiary and Archaean rocks. The region's geological foundation includes the Khondalite, Charnockite, Wayanad Schist, and Peninsular Gneissic

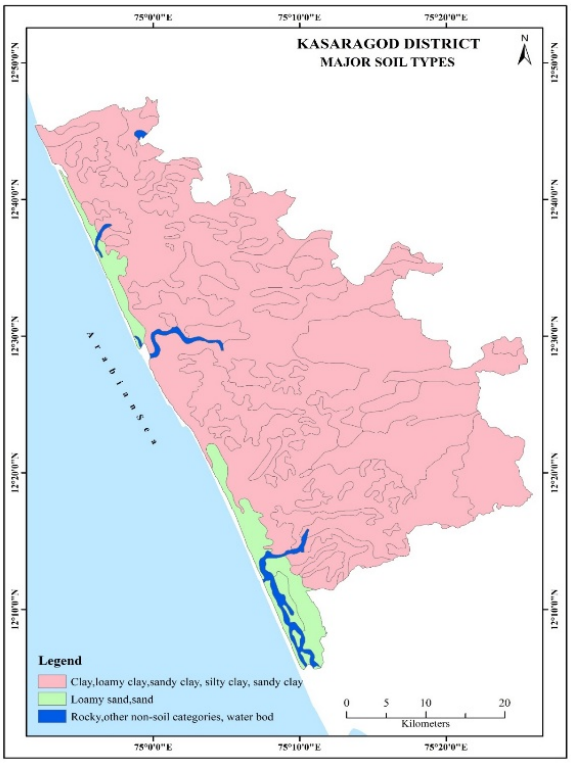
Figure:3 Geomorphology



In the eastern portion is hilly terrain prt of western ghat and the western portion is coastal plain region. The mid land of Kasaragod is plateau terrain.

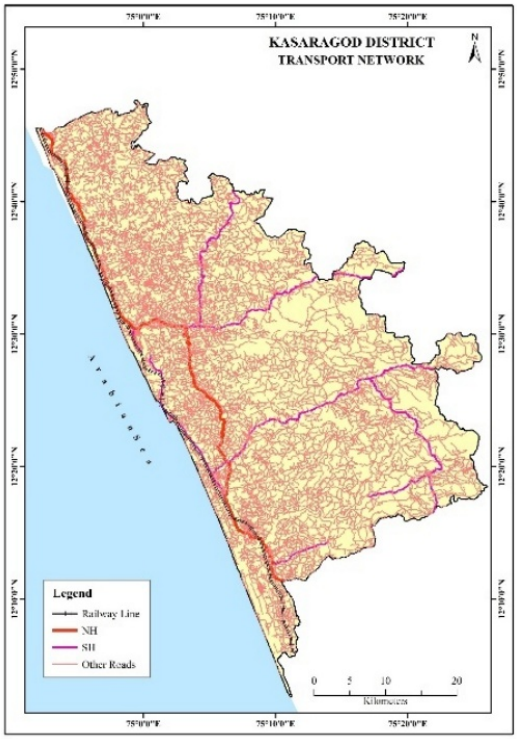
The Western Ghats are the result of ancient tectonic activities, by the rifting and uplifting of the landmass

Figure:4 Soils



The loamy soil, the sandy soil, the clay sandy soil, the silty clay soil are the important soils in Kasaragod district. The region is also dominated by Laterite soil, which is infertile but can support crops with the usage of fertilizers. Laterite rocks are mined very huge amount in Kasaragod for building materials.

Figure:5 Transportation Map of Kasaragod District

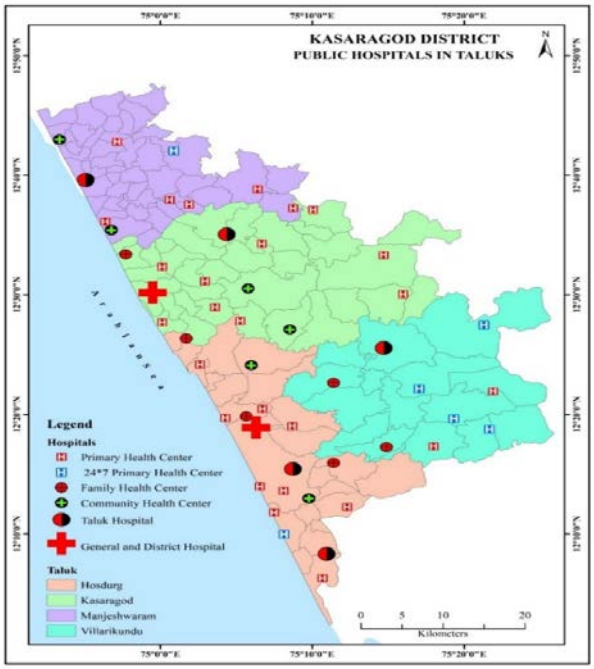


In the district's coastal region, National Highway 66—which links Mumbai with Kanyakumari on India's west coast—connects the important coastal towns of Manjeshwar, Uppala, Kumbla, Kasaragod, Udma, Bekal, Kanhangad, Nileshwaram, and Thrikaripur. The state's whole railway network is 1054 kilometers long. The district has both trains and roads network. The district's railway line is 116 km long and runs through the coastal plain region. State highways are 141.71 kilometres long, important district roads are 1303.049 kilometres long, and other district roads are 527.11 kilometres length.

CHAPTER IV: Geographical Configuration of Public Health Institutions in Kasaragod District and Tertiary Private Health Centres in Kasaragod District

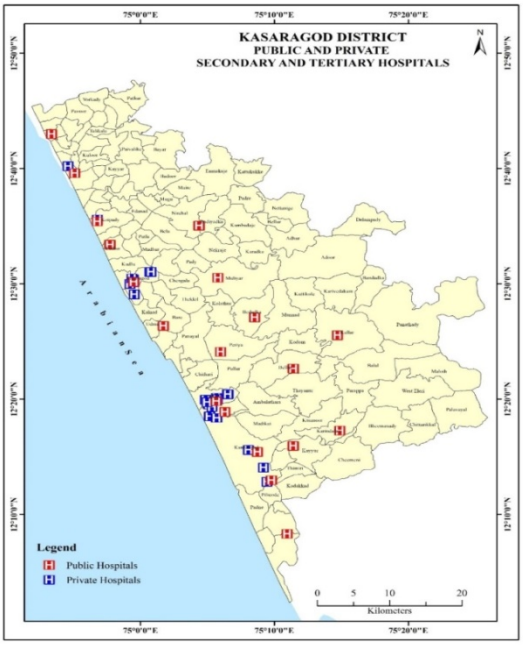
The fourth chapter covers the geographical distribution of public health institutions and tertiary private health centres in Kasaragod District. A GIS tool is utilized to analyse the locations of these healthcare centres.

F igure:6 Public healthcare centres



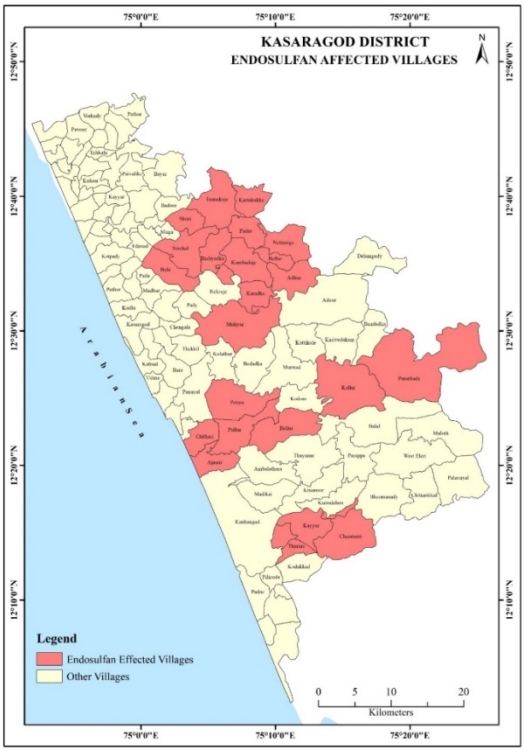
Kasaragod district, characterised by its diverse and unique physiographic structure. The district is divided into four taluks: Kasaragod, Hosdurg, Vellarikundu, and Manjeshwar. Each of these taluks has its own distinct geographical features that contribute to the overall landscape of the region and the distribution all

Figure: 7 Private and Public Hospitals



In this map displays the public and private secondary and tertiary hospitals. In the district, there are 25 private hospitals. The majority of these private hospitals are found in the coastal area of the taluk's Kasaragod and Kanhangad. Since private hospitals have financial incentives to profit from medical services.

Figure: 8 Endosulfan tragedy in Kasaragod District



In 1977 the plantation corporation of Kerala taking care of Cashew sapling on 2190 hectares of land in Kasaragod plantation (in Ranipuram plantation 1526 hectares and in Cheemeni plantation 980 hectares), total 4696 hectares. Ever since that time Endosulfan was sprayed in the region aerially three times a day. The spraying of Endosulfan in the cashew plantations of State-owned Plantation Corporation of Kerala caused a disaster on the biodiversity of this region. Endosulfan is a prevented-use pesticide that is especially effective against aphids, fruit worms, beetles etc. Endosulfan can enter the human from water, food or soil. The people who were living nearby this region have been suffering from various ailment thereafter. Congenital

CHAPTER V: Comparative Analysis of the Disparity in Public Health Service Availability and the Population Distribution

It seems like the investigation focused on assessing the availability of healthcare facilities across different taluks in Kasaragod district using the location quotient method, alongside analysing the spatial distribution of healthcare centres and population using GIS technology.

The fifth chapter provides information on the population status and accessibility of major illness patients in the Kasaragod district to hospitals. The Buffer analysis reports about the accessibility of PHC hospitals for individuals in Kasaragod district.

Location Quotient Analysis

L.Q. formula

$$\text{Location Quotient} = \frac{\text{Total PHC in a Taluk / Total population in the Taluk}}{\text{Total PHC in Kasaragod District/Total population in the district}}$$

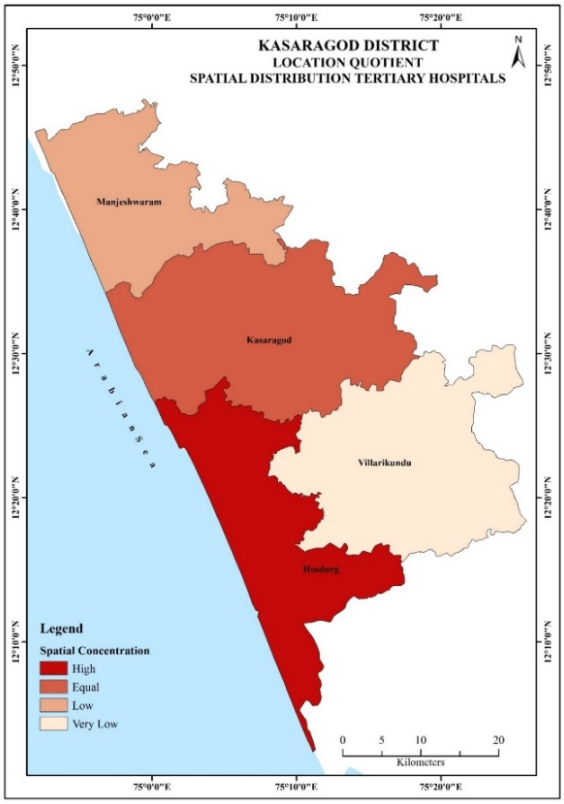
This approach likely aimed to identify areas with the least healthcare facilities relative to their population size, providing insights into disparities in healthcare access within the district. Population density measured and mapped taluk wise using GIS software.

Table: 5.4. Location Quotient of Public Health Care Centres in Kasaragod

Sl. No	Taluk	L.Q. OF PHC	DESCRIPTION of L.Q. of PHC	L.Q. OF 24X7 PHC	Description of L.Q. of 24x7PHC	L.Q. OF FHC	Description of L.Q. of FHC	L.Q. OF CHC	Description of L.Q. of CHC	L.Q. OF THQH/T.H.	Description of L.Q. of THQH	L.Q. of D.H.	Description of L.Q. of D.H.	L.Q. of G.H.	Description of L.Q. of G.H.
1.	Manjeshwar	0.93	Low Spatial Concentration	0.81	Low Spatial Concentration	0.8	Low Spatial Concentration	1.6	High Spatial Concentration	1	Equal Spatial Concentration	0	No Spatial Concentration	0	No Spatial Concentration
2.	Kasaragod	1	Equal Spatial Concentration	0	No Spatial Concentration	0.45	Low Spatial Concentration	1	Equal Spatial Concentration	0.63	Low Spatial Concentration	0	No Spatial Concentration	3.16	Very High Spatial Concentration
3.	Hosdurg	1	Equal Spatial Concentration	0.48	Low Spatial Concentration	1	Equal Spatial Concentration	1	Equal Spatial Concentration	1	Equal Spatial Concentration	2.9	Very High Spatial Concentration	0	No Spatial Concentration
4.	Vellarikund	1.9	High Spatial Concentration	4.9	Very High Spatial Concentration	2	Very High Spatial Concentration	0	No Spatial Concentration	1.47	High Spatial Concentration	0	No Spatial Concentration	0	No Spatial Concentration

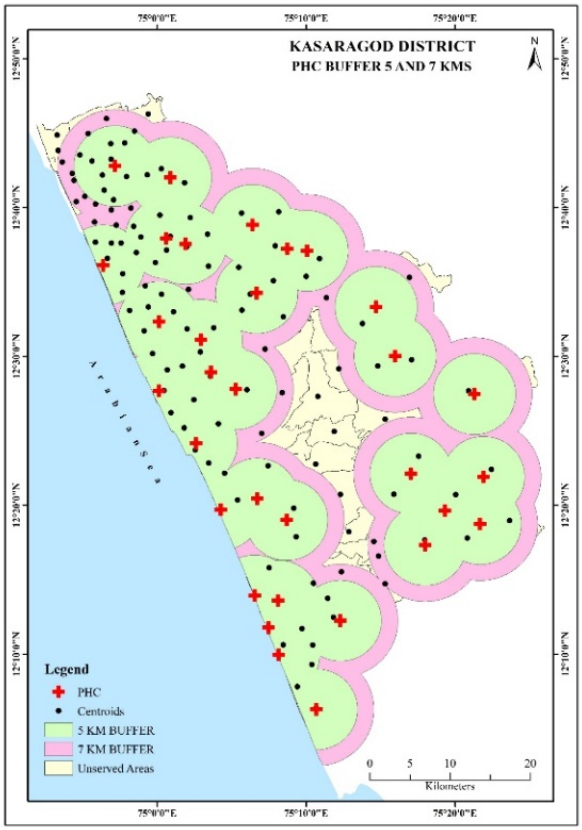
[source: compiled by the Researcher]

Figure: 9 Location Quotient analysis



In Manajeshwar and Vellarikundu taluk have low spatial concentration of tertiary level public healthcare centres. Therefore, the government needs to start implementing additional tertiary public healthcare facilities in these locations. Given the proximity of several multispecialty hospitals in Mangalore city nearness to Manjeshwaram, the Kerala government shouldn't impede the development of medical facilities in Manjeshwaram taluk.

Figure : 8 Buffer Map - PHC



The above buffer map illustrates the distribution of Primary HealthCare Centre (PHC) with 5kms and 7kms buffer zone. In each PHC surrounded by buffering with five and seven kilometres means the residence can travel five or seven kms to reach the nearby PHC. The south-central part of the district has shown as unserved area. This unserved area locates in the Vellarikundu Taluk. There has shortage of PHC. In this area the population distribution and built-up area of settlements are moderately distributed. The unserved area of the PHC exist due to the nearness of the location of the Family Healthcare Centre (FHC) and Community Healthcare Centre (CHC).

The closeness of these secondary level healthcare centres is the reason for the PHC remains unserved in that area. It can understand by reading the following 3 maps of built-up area map, population distribution map, and the location of all public healthcare centre map.

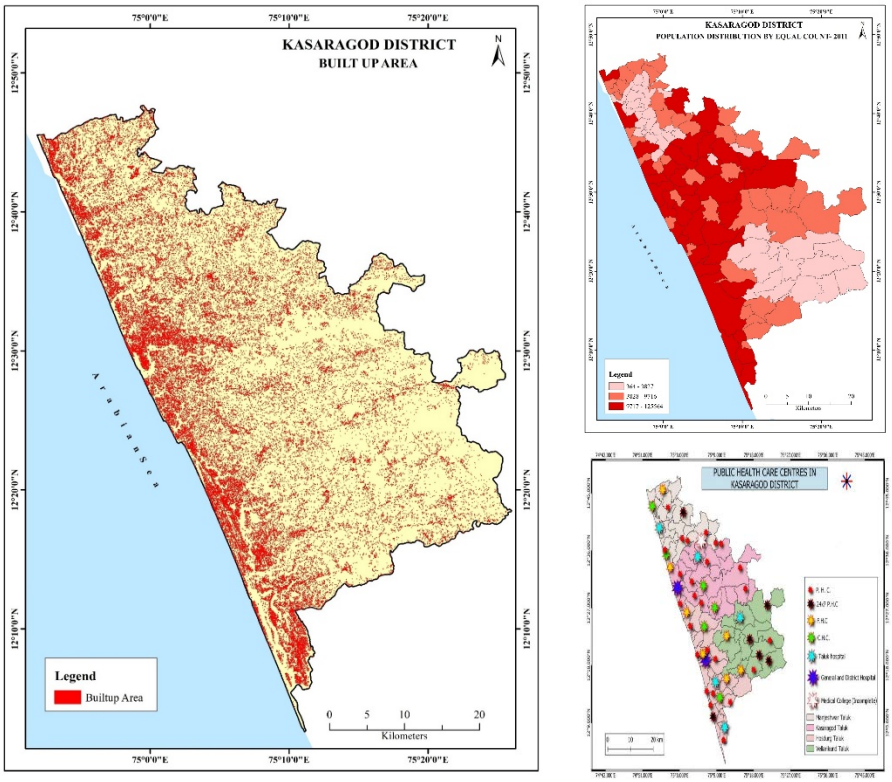
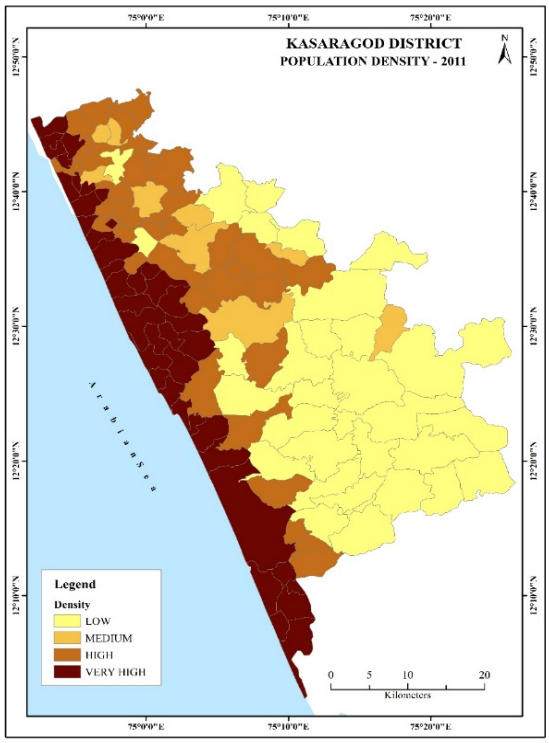


Figure : 9 Density of Population



This density distribution map illustrates that, very high-level population density in the western coastal plain area. In the middle part of the district has moderate population and the eastern portion of the district have low level of population density.

CHAPTER VI: THE WORKFORCE AND INFRASTRUCTURE OF THE PUBLIC HEALTH CARE CENTRES IN KASARAGOD DISTRICT

In the seventh chapter, it appears that the Workforce and infrastructure facilities of randomly selected healthcare centres in Kasaragod were examined and analyzed. This analysis likely involved assessing various aspects of infrastructure such as the availability of medical equipment, the condition of facilities, staffing levels, and other factors that contribute to the quality of healthcare services provided in the region

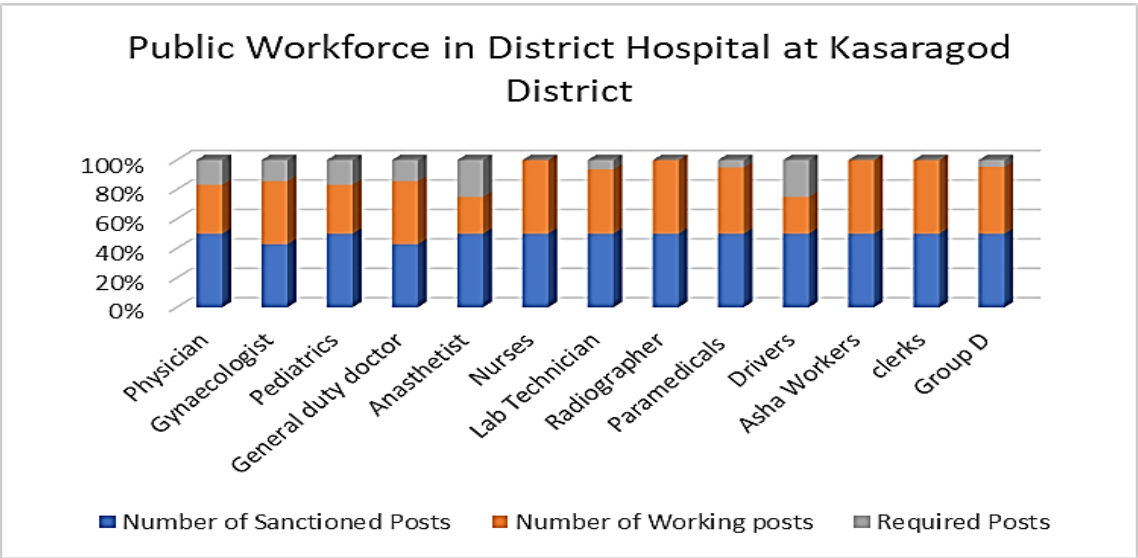
1. Tertiary level District Hospital Kanhangad

Table 1. The Public Health District Hospital Workforce in Kasaragod District:

Sl.No	Name of Workforce in District Hospital	Number of Sanctioned Posts	Number of Working Posts	Required Posts
1	Physician	3	2	1
2	Gynaecologist	3	3	1
3	Paediatrics	3	2	1
4	General duty doctor	3	3	1
5	Anaesthetist	2	1	1
6	Nurses	68	68	0
7	Lab Technician	8	7	1
8	Radiographer	3	3	0
9	Paramedical	231	208	23
10	Drivers	4	2	2
11	Asha Workers	11	11	0
12	Clerks	6	6	0
13	Group D	44	40	4

[Source: District Health Office Kanhangad]

Figure 10. Workforce in District Hospital



[source: Compiled by Researcher]

A paramedic is a trained medical practitioner who treats patients in an emergency. In an emergency, he or she is essential to the patient's life preservation. Being a paramedic requires a high level of competence and significant training. An expert in emergency medicine, a paramedic usually practices outside of a hospital. In their assigned communities, they manage a range of emergency and urgent medical conditions. Emergency Response: Paramedics are the ones that drive ambulances to patients who require emergency treatment and attention.

Treatment on-site: As soon as they arrive, they carry out a variety of procedures, such as bandaging, resuscitation, CPR, and wound sterilizing. Patient Transfer: Paramedics stabilize the patient's condition and take them to a hospital if treatment at the current location is insufficient. They make advance contact with the hospital to offer helpful details regarding the patient's condition.

Documentation: Following the emergency response, the crisis and the protocols for treatment are recorded.1. Distinction from EMTs: While EMTs are entry-level professionals certified to conduct common treatment methods, paramedics are capable of performing more complex treatment procedures involving physiology, cardiology, and anatomy.

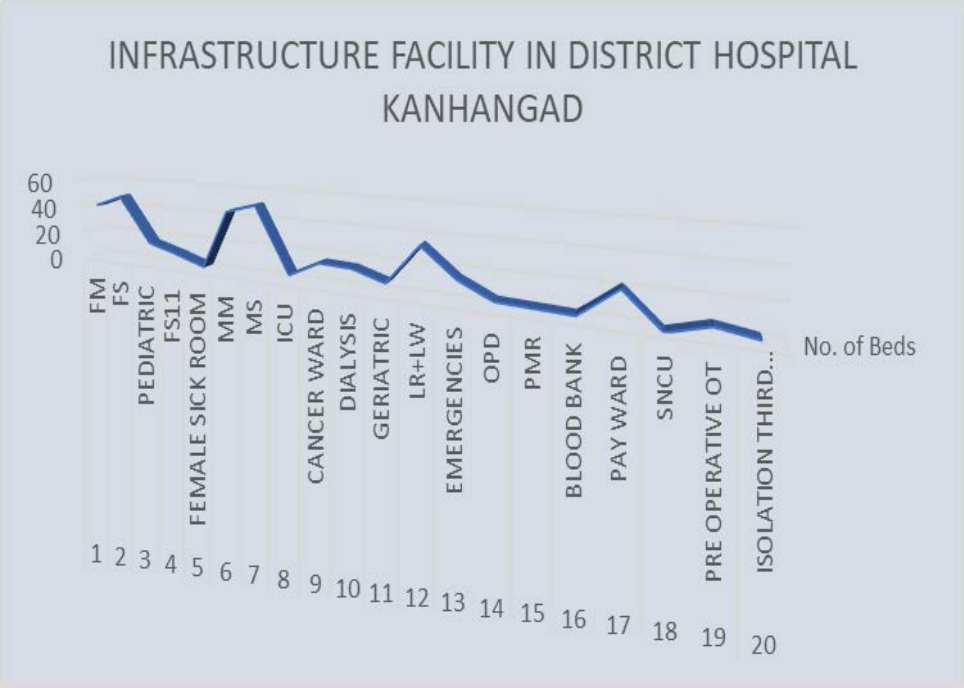
The District Hospital in Kasaragod has 208 active paramedical positions despite having 231 sanctioned positions. There are three paediatricians on staff here, however there are only two positions available. Three physician positions are authorized: two are for working positions, and one is needed. Three positions for gynaecologists are available. There are three general duty doctor postings. One of the two authorized positions for anaesthetists is currently in service. It contains 68 nurses. Eight post-sanctioned lab technicians—seven of whom are employed one is needed. Three radiologists work there. There are eleven posts for Asha workers here. There are four authorized post-2 divers at work.

There are 44 Group D sanctioned roles 40 of which are active four of the posts are necessary and 6 clerk positions.

Table 2. Infrastructure in District Hospital Kanhangad

Sl. No.	Departments In District Hospital Kanhangad in 2024	No. of Beds
1	Female Medical ward	41
2	Female Surgical ward	49
3	PEDIATRIC	16
4	Female Surgical ward 11	10
5	FEMALE SICK ROOM	3
6	Male Medical ward	45
7	Male Surgical ward	51
8	ICU	5
9	CANCER WARD	16
10	DIALYSIS	15
11	GERIATRIC	8
12	Labour Room+ Labour Ward	35
13	EMERGENCIES	16
14	Outpatient Department	5
15	Physical Medicine & Rehabilitation	4
16	BLOOD BANK	3
17	PAY WARD	22
18	Special Newborn Care Unit	NO BEDS
19	PREOPERATIVE Operation Theatre	7
20	ISOLATION THIRD FLOOR	3(NOT FUNCTIONAL)
	Total	364

Figure 11. Healthcare Infrastructure in District Hospital



The District Hospital in Kanhangad is the largest public healthcare facility in Kasaragod, playing a vital role as a tertiary hospital offering specialized care and treatments that smaller centres can't provide. It has a variety of wards to meet the diverse medical needs of its patients. The hospital has 41 beds in the female medical ward, 49 beds in the female surgical ward, and 10 beds in an additional female surgical ward. For women in critical condition, there's also a sick room with 3 beds. The male wards include 51 beds for surgical care and 45 beds for general medical treatment. The paediatric ward has 16 beds for children, and the ICU offers 5 beds for critically ill patients. There are specialized wards for cancer care (16 beds), dialysis (15 beds), and elderly care (8 beds). For maternity care, the hospital has 35 beds in the combined labour and delivery wards, ensuring multiple women can be cared for simultaneously. The emergency ward has 16 beds for urgent medical situations. There are 5 beds in the outpatient department (OPD) for routine consultations and treatments. The hospital also has 3 blood bank storage rooms to manage blood donations for surgeries and emergencies. For patients seeking more comfort, the pay ward offers 22 beds for private accommodation. However, the special infant care unit (SICU) is currently unavailable, and the isolation ward is not operational at the moment. The preoperative operation theatre has 7 beds for patients preparing for surgery. With a total of 364 beds, the District Hospital in Kanhangad is well-equipped to address both emergency and long-term care needs, making it a crucial healthcare hub for the region.

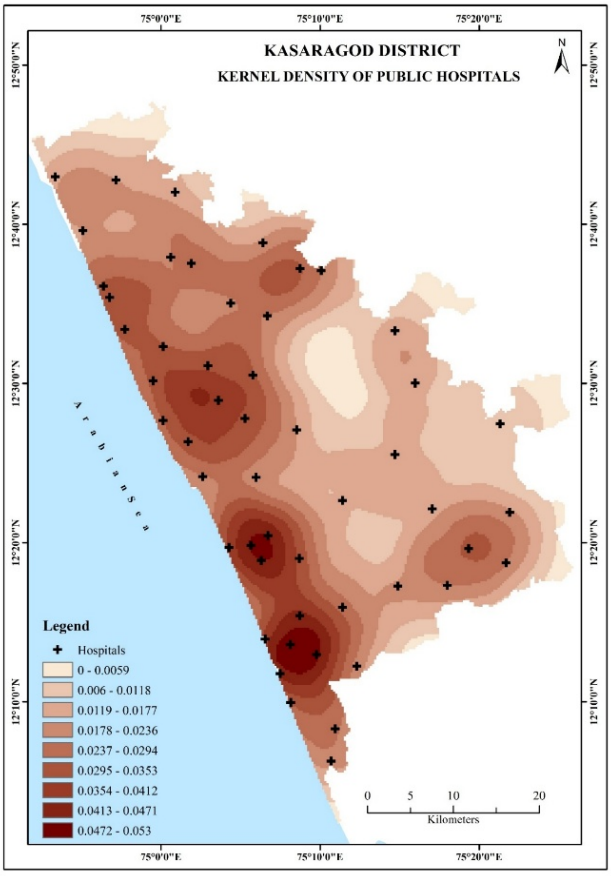
CHAPTER VII: ACCESSIBILITY OF HEALTHCARE SYSTEM IN KASARAGOD DISTRICT

The Kernel density maps help improve healthcare planning and delivery by providing valuable insights into access patterns.

Kernel density maps in GIS are powerful tools for studying healthcare access for several reasons:

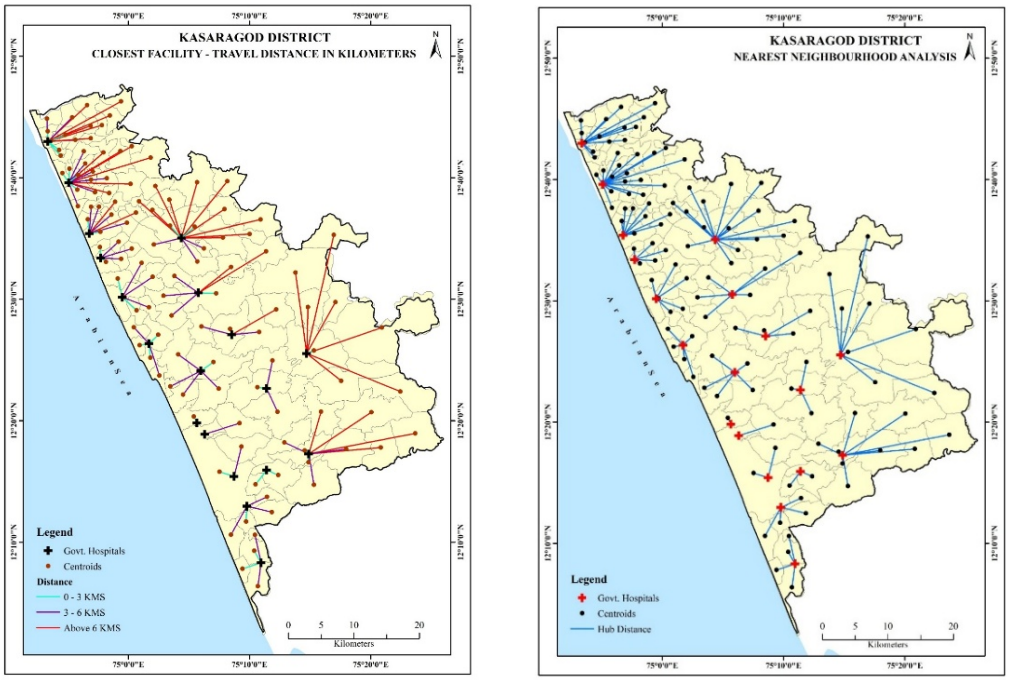
1. Clear Visualization: They show easy-to-read maps that highlight areas with high or low access to healthcare, making it simple to spot trends and needs.
2. Identifying Underserved Areas: These maps help find regions with limited healthcare, revealing communities in need of more services.
3. Resource Planning: Kernel density maps guide decisions on where to place new clinics or mobile services, ensuring resources go where they're most needed.
4. Evaluating Interventions: By comparing maps before and after healthcare changes, researchers can measure their effectiveness and make improvements.

Figure 11: Kernal Density Map of Public Healthcare Centres



The kernel density map of public hospitals shows a high concentration of healthcare centres in the coastal regions of the western part of the district, due to the dense population in this area. In contrast, the eastern part of the district is sparsely populated and has fewer healthcare centres. As a result, residents in the eastern part of the district must travel long distances to access tertiary healthcare centres, which can be problematic during emergencies. Therefore, establishing tertiary healthcare centres in the northeastern and southeastern areas is crucial. This would help address the current disparity in healthcare access, ensuring that residents in these regions have closer proximity to essential medical

Figure 12. Nearest neighbour analysis and closest facility method



In a nearest neighbour analysis, this map displays the proximity of PHC to secondary and tertiary public hospitals. Patients are referred by PHC medical officers to the closest secondary or tertiary public hospitals. People from low-income backgrounds primarily rely on government healthcare facilities.

The map of the closest healthcare facilities above illustrates the travel distances people need to cover to reach medical services, categorized into three distinct distance ranges: below 3 km, between 3 to 6 km, and above 6 km. This classification helps us understand the accessibility of secondary and tertiary hospitals for local residents based on their proximity to healthcare centers.

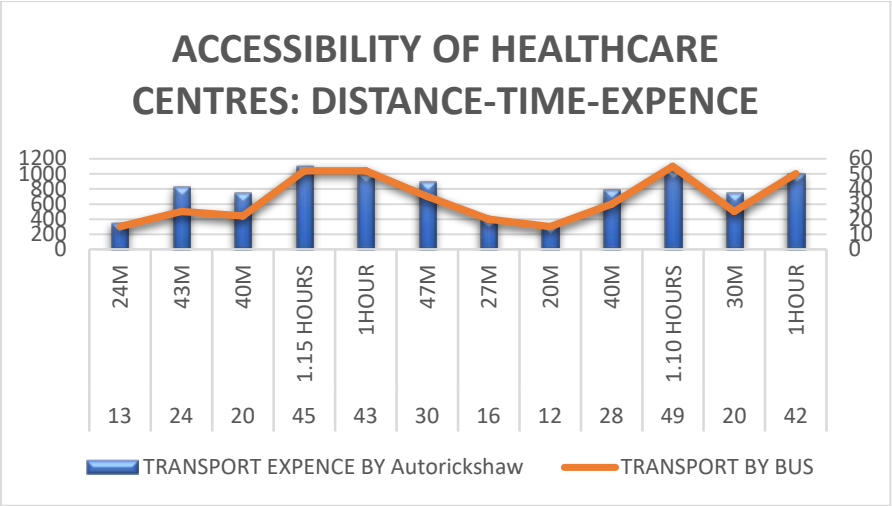
Table 3. Anova Test of Distance-Time-Mode of Transport and Cost

Anova: Single Factor						
SUMMARY						
Groups	*Count*	*Sum*	*Average*	*Variance*		
DISTANCE in KM	12	342	28.5	174.6364		
TIME in minutes	12	536	44.66667	331.5152		
TRANSPORT EXPENCE BY Autorickshaw	12	9250	770.8333	75553.79		
TRANSPORT BY BUS	12	396	33	234		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	4869578	3	1623193	85.10204	2.4E-18	2.816466
Within Groups	839233.3	44	19073.48			
Total	5708811	47				

(Source: Compiled by Researcher)

The P-value of 0.000000000000024 is much smaller than 0.05, indicating statistical significance. This means the null hypothesis is rejected, and the findings are significant. The ANOVA results suggest that factors like travel distance, time, and transportation costs significantly affect access to public tertiary health centres in the Kasaragod district.

Figure 12. Accessibility of Healthcare Centres



(Source: Compiled by Researcher)

In the seventh chapter, it seems that a detailed description of the accessibility of healthcare centres was provided. This likely involved analyzing factors such as transportation routes, travel times, and geographic distribution to determine how easily people in different areas of Kasaragod can reach healthcare facilities.

The chapter may have also explored any barriers or challenges to accessing healthcare services in the district. Kernal density estimation tool, Nearest neighbourhood analysis, Anova test analysis are measured to investigate the accessibility of healthcare system in the district.

CHAPTER VIII: An investigation of the socioeconomic circumstances of major patients and their challenges in accessing multispecialty hospitals. The following is information collected through primary data:

Respondence Result Evaluation

There are 122 Kasaragod residence reply of questionnaire was depicted the following data analysis

Table 4 Respondents fall under the Age Group

AGE GROUP of Male Respondent	**FREQUENCY**	**PERCENT**
Age group between 0 to 18	17	13.9
Age group between 19 to 49	29	23.8
Age group above 50	76	62.3
Total	122	100
Age group of Male	**Frequency**	**Percent**
Age group between 0 to 18	7	11.7
Age group between 19 to 49	12	20.0
Age group above 50	41	68.3
Total	60	100.0
Age group of Female Respondent	**Frequency**	**Percent**
Age group between 0 to 18	10	16.1
Age group between 19 to 49	17	27.4
Age group above 50	35	56.5
Total	62	100.0

This chapter likely provides an analysis of how factors such as income level, education, and geographical location affect access to healthcare services for people with serious illnesses in that region. Factor analysis is used here to mention socio economic aspects of major diseased patients.

Table 8.10. Male and Female Respondent's Travelling Distance toward Tertiary Hospitals

Male Respondents Travelling Distance for Tertiary Hospitals	**Frequency**	**Percent**
less than 25 kilometres	16	26.7
25 to 50 kilometres	18	30.0
above 50 kilometres	26	43.3
Total	60	100.0
Female Respondents Travelling Distance for Tertiary Hospitals	**Frequency**	**Percent**
less than 25 kilometres	23	37.1
25 to 50 kilometres	11	17.7
above 50 kilometres	28	45.2
Total	62	100.0

There are 122 patients survey shows that more than 25 kms, 25 to 50 kms and above 50 kms travelling distance to tertiary hospital.

Table 4 Statistics of male and Female Respondent's Age and Distance travailing for Tertiary Hospitals:

Statistics of Female Respondent's Age and Distance Travel for Tertiary Hospitals		
Statistics	**Age**	**Distance**
Mean	48.5161	50.5323
Std. Deviation	20.59504	30.60468
Minimum	2.00	10.00
Maximum	80.00	120.00

Statistics of Male Respondent's Age and Distance travel for Tertiary Hospitals		
Statistics	**Age**	**Distance (In km.)**
Mean	53.5167	50.35
Std. Deviation	18.99375	30.48
Minimum	13.00	07.00
Maximum	88.00	150.00

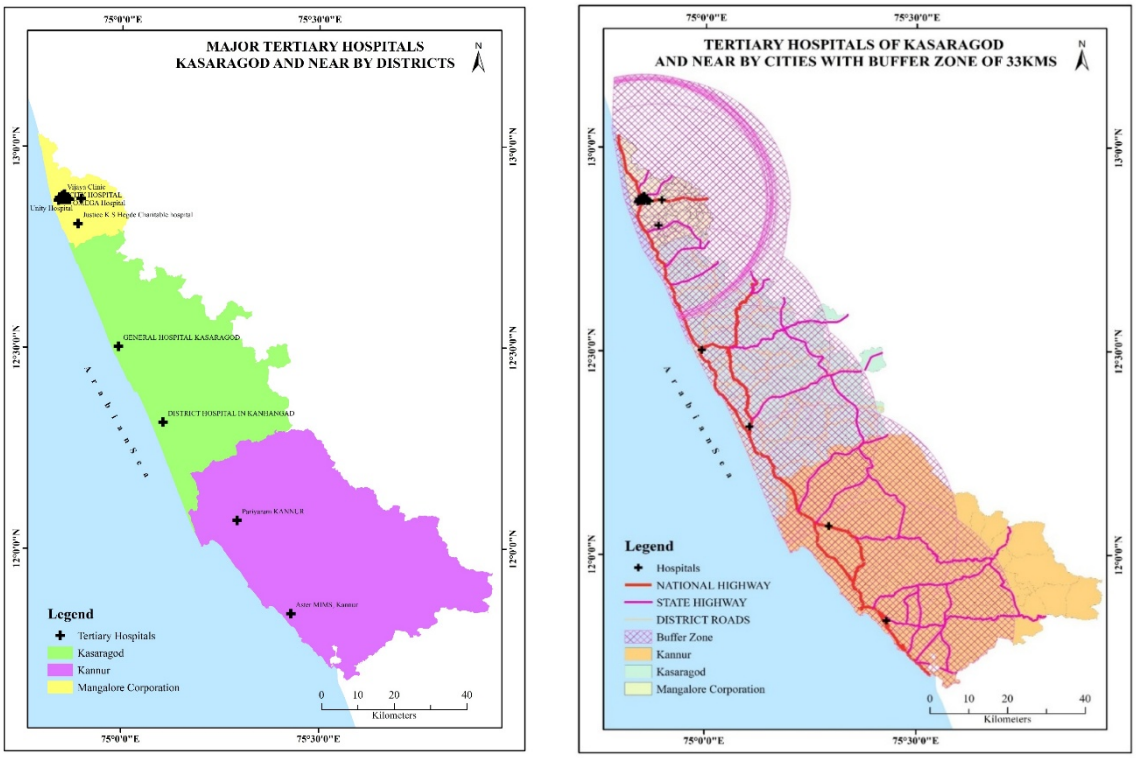
In this study the average age of male patient is 53 years and the average age of female patient is 48 years. The mean distances of male and female patients want to travel for treatment is 50kms. The Kasaragod patients travelling long distances as a treatment for major ailments can be very painful.

Road Map of Adjoining districts Mangalore in Karnataka state and Kasaragod and Kannur in Kerala state: Road network of Kasaragod District sharing nearest Mangalore city in Karnataka depicted the following map. The Arabian Sea is situated on the western side of Kasaragod. Likewise, the road network also runs parallel to the Arabian Sea. In the western part of the district, the national highway run parallel to the coastline area. State roads intersect with national highways in the district's western section. The state highways are served by the eastern parts of the district. The national highway (N.H.66) indicates red in colour, that is passes near the coast. The pink colour line are state highways and the yellow colour line represents district roads.

The Buffer analysis of multi-speciality hospitals in Mangalore-Kasaragod and Kannur:
The below map represents the location of private and public multi-speciality hospitals and its buffer in Mangalore, Kasaragod and Kannur district. In the emergency case of medical needs people depends Mangalore city for treatment. There are above 20 muti-speciality hospital in Mangalore serves not

only Mangalore residence but also Kerala district such as Kasaragod, Kannur, even from Kozhikode residence. In this there are 33km buffering zone is marked.

Figure 12. Tertiary hospitals of Kasaragod and its nearest cities- buffering with 33 kms

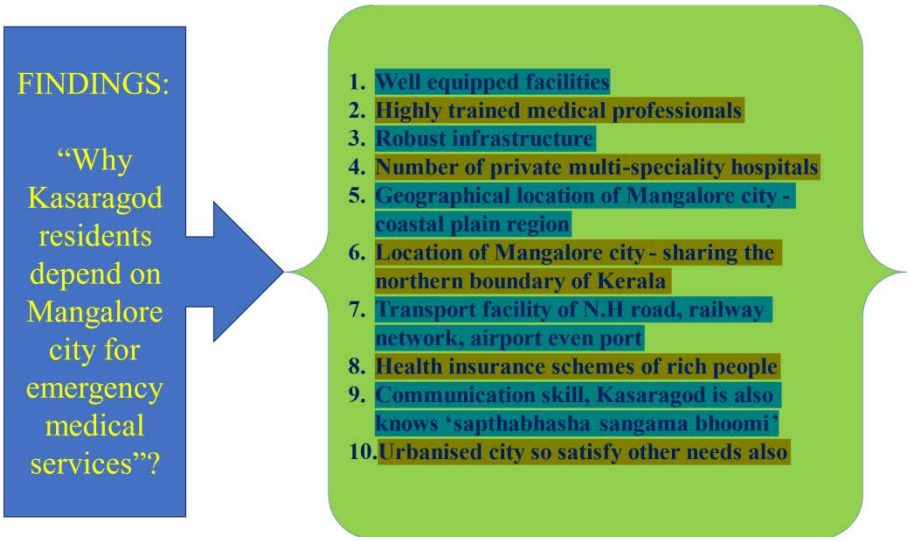


The above figure shows that most of the patients in Kasaragod district depending nearby cities tertiary level hospitals such as Mangalore in the north and Kannur in the south for major treatment because of lack of treatment in their own district. There are more than 20 multi-speciality private hospitals situated in Mangalore city. Mangalore city is an educational hub. Most of the students from Kerala depend the Mangalore city in Karnataka for higher level of Academic purpose.

CHAPTER IX: SUMMARY AND FINDINGS

The nineth chapter includes the summary and findings the whole thesis, clearly identified the problems in healthcare system in the study area, the findings of the study, and the steps taken to solve them as recommendations.

Figure 9.1. Reasons for Kasaragod residence depends Mangalore city for Tertiary hospitals


FINDINGS:
"Why Kasaragod residents depend on Mangalore city for emergency medical services"?
1. Well equipped facilities
2. Highly trained medical professionals
3. Robust infrastructure
4. Number of private multi-speciality hospitals
5. Geographical location of Mangalore city - coastal plain region
6. Location of Mangalore city - sharing the northern boundary of Kerala
7. Transport facility of N.H road, railway network, airport even port
8. Health insurance schemes of rich people
9. Communication skill, Kasaragod is also knows 'sapthabhasha sangama bhoomi'
10. Urbanised city so satisfy other needs also

(Source: observation and experiential method as a resident in Kasaragod district by Researcher)

This study provides a spatial analysis of the distribution and accessibility of healthcare facilities in Kasaragod district, using GIS tools to map both public health centres and private tertiary healthcare facilities. The analysis highlights significant disparities in the availability of public healthcare services across different Taluks, revealing a low spatial concentration of services in Vellarikundu and Manjeshwaram, while Hosdurg and Kasaragod Taluks show higher concentrations of healthcare resources. Furthermore, a workforce analysis identifies a critical shortage of staff, including doctors, nurses, lab technicians, and health assistants, at various public healthcare institutions, such as Primary Health Centres (PHCs), Community Health Centres (CHCs), Taluk hospitals, and District General Hospitals. The study also evaluates the accessibility of tertiary healthcare facilities in the district through various GIS techniques, including Kernel Density Estimation, Closest Facility, Nearest Neighbour Analysis, Buffer Analysis, and ANOVA testing, considering factors such as distance, time, and cost. A survey of 122 major patients from Kasaragod reveals that 50% travel to Mangalore city for treatment, primarily due to the inadequacy of healthcare infrastructure in their home district. Mangalore, being the nearest city, offers a wide range of private multispecialty hospitals, and Kasaragod residents also depend on it for education, shopping, and entertainment. The findings underscore the need for substantial improvements in Kasaragod's tertiary public healthcare system to make the district self-sufficient, particularly in light of challenges faced during the COVID-19 pandemic when district and state borders were closed.

Conclusion

The Kasaragod district has three different types of landmasses:

1) Coastal area
2) Midland
3) High terrain

West of Kasaragod lies the Arabian Sea coast, east is located with the Western Ghats, south is Kannur district, and north is Karnataka state's Dhakshina Kannada District. Because of plain region the people live in densely around the Coastal area. Although Midland is populated more, there are less populated in the high land region.

The population of Vellarikundu taluk is lower than that of other Taluks. It is situated in a hilly region. The other three taluks named as Kasaragod, Manjeshwaram, and Hosdurg, which are situated in the midland and coastal plain regions, respectively.

The entire community in Kasaragod district is requesting to government for medical development, including the establishment of AIIMS hospital and the project completion of the building and operation of the medical college in Ukkinaduka in Manjeshwaram Taluk, due to the shortage of the tertiary healthcare system in this area. The government must grant this society's need for justice and sanction it in order to enhance health sector.

The Ukkinadukka Medical College at Kasaragod district in Kerala laid its construction foundation in the year 2013 now also incomplete, is a significant healthcare infrastructure project that needs to be completed at the earliest. The construction work for the medical college has been underway for some years, but it is an inability for the Kerala government to expedite the process and enable its timely completion. The establishment of this medical college is significantly important for the district, which currently lacks sufficient tertiary healthcare system in the study area. The medical college will provide much-needed access to quality medical education and training for students, improve healthcare services to residence, and help reduce the need for residents to travel to Private Multi-speciality hospital in Mangalore city for specialized treatments. The medical college will also contribute to employment opportunity for residence and economic development in the district, becoming a significant resource for the surrounding society. At present condition the incomplete medical college is the platform for PHC.

The completion and inauguration of Ukkinadukka Medical College should be prioritized to benefit both current and future generations of the residence. Immediate action is required to finish the construction works and start medical courses as soon as possible to fulfil the tertiary level healthcare needs of Kasaragod district.

In January 2025, it was announced by Kerala Government that the Kanhangad District Hospital will be converted into a medical college, signalling development in the region's healthcare system. However, this decision also underscores the ongoing delays in completing the Ukkinadukka Medical College because of the Kerala government's financial mismanagement and lack of proper planning. But The National Medical Commission (NMC) rejected this proposal because the medical college campus is over 50 km away from the District Hospital, which would take about an hour and a half to travel to reach hospital from campus. As per NMC guidelines, a medical college can only for a Government District Hospital as its teaching hospital if it is within 10 km or a 30-minute journey to reach hospital. However, officials from the Directorate of Medical Education have considered that a fully operational hospital will take at least two more years to complete. The incomplete construction of Ukkinadukka Medical College is a important concern, especially for the residence in Kasaragod district, where many Endosulfan victims reside in Kasaragod district. These individuals, already facing critical health issues, urgently require access to advanced healthcare system and specialized medical care, making the timely completion of Ukkinadukka Medical College even more critical condition. The government's failure to medical sector shows this issue as the community without essential resources healthcare sector.

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List of Research Article Publications of the Author:

1. Inadequate healthcare facilities despite Endosulfan affected area in Kasaragod District. **DOI url:** https://doi.org/10.30574/ijsra.2023.8.1.0133
2. An Analysis of the Distribution of Healthcare Facilities, the Population, and the Health Workforce in the Kasaragod District on a Taluk-By-Taluk Basis. DOI: https://doi.org/10.52403/ijhsr.20231045
3. Geographical Configuration and Accessibility of Tertiary Health Centres in Kasaragod. doi : https://doi.org/10.32628/IJSRST

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1. IGS - International E-Conference on “EARTH SCIENCES AND SUSTAINABLE DEVELOPMENT GOALS” Conducted from 5th to 7th August, 2021 by Dept of Geography, Osmania University, Hyderabad, Telangana in Collaboration with the Indian Geographical Society, Chennai.
2. International Multidisciplinary Conference on Recent Trends in Global Warming and Climate Change: It’s Impact on Environment and Biodiversity Date: 12- 13 February 2021
3. International Conference (Online) on “Challenges of Disasters: Vulnerability, Adaptation and Resilience”, Organized by the Centre for Disaster Management, Department of Geography, Jamia Millia Islamia, New Delhi during March 02-03, 2021.
4. **43rd Indian Geography Congress October 28-30, 2021** Focal Theme Population, Environment, Health, Sustainable Development Goals and Appropriate Technologies: Post-COVID-19 Scenarios Organized by Department of Geography, Institute of Science Banaras Hindu University Varanasi, U.P.
5. Union of Geographic Information Technologists (UGIT’s) Department of Geography & Geoinformatics, Science Forum Bangalore University UGIT’s 12th International Conference Climate Change and Sustainable Development of Natural Resources - Applications of Geospatial Technologies.
6. TROPICAL BIOSUMMIT’24 AN INTERNATIONAL CONFERENCE ON BIO DIVERSITY AND SUSTAINABLE FUTURE 8,9,10-JUNE-2024 FAROOK COLLEGE CALICUT, KERALA.
7. “Multi-disciplinary Approach for Sustainable Development of Future Cities - Innovative Emerging Technology” the 13th UGIT'S International Conference Bangalore University on 19TH - 20TH DECEMBER 2024 and
8. **International Seminar on "Climate Change and Sustainability: Physical Dynamics, Social Vulnerability, and Community Resilience"**, held from **February 4–6, 2025**, at Swami Anandatheertha Campus, Payyannur, Kannur, Kerala.

Participation details:

ATTENDED REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEM (GIS) COURSES/ THE INTERNATIONAL E WORKSHOP/ INTERNATIONAL SEMINAR/ NATIONAL WEBINAR:

1. MIZORAM CENTRALUNIVERSITY NAAC A GRADE (2019-2024)
   PROFESSOR RAMAKAR JHA, DEPARTMENT OF CIVIL ENGINEERING NIT-PATNA presented "UNDERSTADING OUR RIVERS OF HILLY REGION AND ITS CONSERVATION" held on 14/08/2020.
2. AICTE SPONSERED SHORT TERM TRAINING PROGRAM ON "BASIC OF REMOTE SENSING, GEOGRAPHICAL INFORMATION SYSTEM(GIS) AND GLOBAL NAVIGATION SATELLITE SYSTEM(GNSS) PHASE 1" organized by DEPARTMENT OF CIVIL ENGINEERING FRANCIS XAVIER ENGINEERING COLLEGE TRIRUNELVELI, TAMILNADU held on 17th to 22nd /08/2020
3. YUVAKSHETRA, INSTITUTE OF MANAGEMENT STUDIES PALAKKAD, KERALA organized 5 DAY WEBINAR on "EMERGING PERSPECTIVES IN EARTH SCIENCES" held on 19th to 24th /8/2020.
4. 3 DAYS INTERNATIONAL E WORKSHOP on "ADVANCED MICROPALEONTOLOGY organized by DEPARTMENT OF GEOLOGY AND ENVIRONMENTAL SCIENCE, CHRIST COLLEGE IRINJALAKUDA, KERALA. In collaboration with DEPARTMENT OF GEOLOGY, UNIVERSITY OF MADRAS, CHENNAI, INDIA held on: 25th to 27th /08/2020.
5. "INTRODUCTION TO GIS" 5 DAYS ONLINE PRACTICAL TRAINING PROGRAMME conducted on 25th to 30th /08/2020, organized by 'ZEITNAH INSTITUTE OF SURVEY AND GIS', KOZHIKODE in KERALA.
6. NATIONAL WEBINAR ON BEYOND THE BOUNDARIES: SAGA OF BURGEONING URBAN, ERODED COAST AND SUSTAINABILITY organized by P.G DEPARTMENT OF GEOGRAPHY, FAKIR MOHAN UNIVERSITY at BALASORE in ODISHA, held on 28/08/2020.
7. 2 DAYS ONLINE INTERNATIONAL SEMINAR ON NEIGHBOURHOOD POLICY OF INDIA: COTEMPORARY DIPLOMATIC DISCOURSE organized by Department of Political Science. MAHARANA PRATAP P.G COLLEGE, UTTAR PRADESH held on 29th to 30th/08/2020.

8. “21 DAYS ONLINE GIS TRAINING PROGRAMME USING QGIS SOFTWARE” conducted by THE DEPARTMENT OF GEOGRAPHY, EARTH SCIENCE, CENTRAL UNIVERSITY OF KARNATAKA, INDIA, jointly with STATE INSTITUTE OF URBAN DEVELOPMENT, KARNATAKA, held on: 7/9/2020 to 27/9/2020.
9. MIZORAM UNIVERSITY- A CENTRAL UNIVERSITY established by an Act of Parliament Accredited ‘A’ Grade by NAAC in 2019 AIZAWL, INDIA organized National Webinar on “INTEGRATING ENERGY, CLIMATE CHANGE AND DEVELOPMENT, conducted by Department of Management. The lecture delivered by Professor AMIT GARG from INDIAN INSTITUTE OF MANAGEMENT AHMEDABAD held on 08/09/2020.
10. SYMBIOSIS INSTITUTE OF GEOINFORMATICS, SYMBIOSIS INTERNATIONAL (Deemed University) organized An International Webinar on “SPATIAL INTELLIGENCE FOR REAL WORLD SOLUTION” (about GIS and Remote Sensing) held on 16/09/2020 to 18/09/2020.
11. GEOSPATIAL TECHNOLOGY FOR SMART AGRICULTURE AND SMART CITY MANAGEMENT organized by GAH- GEOSPATIAL AWARENESS HUB held on 16/09/2020.
12. AICTE sponsored SHORT TERM TRAINING PROGRAM ON “BASIC OF REMOTE SENSING GEOGRAPHICAL INFORMATION SYSTEM (GIS) AND GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS) PHASE 2” organized by DEPARTMENT OF CIVIL ENGINEERING FRANCIS XAVIER ENGINEERING COLLEGE TRIRUNELVELI, TAMILNADU held on 21th to 26nd /09/2020
13. ONLINE COURSE ON UNDERSTADING OF COASTAL OCEAN PROCESSES using REMOTE SENSING AND NUMERICAL MODELLING conducted by INDIAN INSTITUTE OF REMOTE SENSING (IIRS) DEHRADUN, ISRO, GOVERNMENT OF INDIA, and DEPARTMENT OF SPACE held on 21/09/2020 to 25/09/2020.
14. G.H. RAISONI UNIVERSITY, AMRAVATI (M.S) one day National Workshop on “HOW TO PLAN A RESEARCH” organized by Research and Development Cell of G.H. RAISONI UNIVERSITY AMARAVATHI held on: 03/10/2020.
15. AICTE sponsored SHORT TERM TRAINING PROGRAM ON “BASIC OF REMOTE SENSING GEOGRAPHICAL INFORMATION SYSTEM (GIS) AND GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS) PHASE 3” organized by DEPARTMENT OF CIVIL ENGINEERING FRANCIS XAVIER ENGINEERING COLLEGE TRIRUNELVELI, TAMILNADU held on 26th to 31st /10/2020.

16. The International Conference (**virtual**) 2022 on **"Geospatial Pathways and Big Data Analytics in Natural Resource Applications and Climate Change"** during 16-17 June 2022 Organized Jointly by the Department of Geoinformatics, Central University of Jharkhand (CUJ), Ranchi, Indian Society of Geomatics (ISG), Ranchi Chapter, and Vigyan Bharati Jharkhand.